5.0 Applying FAA Human Factors Research Outputs to Safety Practice

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1.0 Introduction

Good Morning. Thank you for the invitation to participate in this symposium. It is a pleasure to be on this distinguished panel.
You may have noticed by now that I am not Nick Lacey as your program indicates. Nick had to attend to some higher priorities established by the FAA Administrator and sends his regrets. As many of you can imagine, life in headquarters is very demanding and as much as we would like to, we simply cannot participate in every forum no matter how much it relates to our mission.

I am delighted to be able to attend in Nick's place. I am the senior executive in charge of the Continuous Airworthiness Maintenance Division in the Flight Standards Service and report directly to Nick. My division is responsible for all policy and rulemaking as it relates to aircraft maintenance and avionics.

As I look around this distinguished audience I see an excellent representation of manufacturers, airlines, the military, universities, and regulatory agencies. I am pleased to see many young people present because soon they will be guiding our industry during the future of increasing passenger growth and the emergence of new generation aircraft and aviation systems. The large representation of senior staff shows me that our industry management recognizes the importance of managing human performance ***for increased safety. Regardless*** of your experience or job title, it Is the shared goal of increased safety that draws you here to Vancouver. I am pleased to see novices as well as experts here.

We all share the goal of ensuring the highest level of safety for aviation operations. Regardless of the government or regulatory affiliation, safety is the top priority. As an international community we are doing an excellent job. While the number of departures worldwide are on the increase the number of incidents and accidents are holding relatively steady. However, we have seen the statistics and we know that we must lower the accident rate, especially as the number of departures increase annually at a rate of 5 to 10%, depending on your country. So, there are many opportunities for improvement and symposium's like this one can and must contribute to our collective approaches to promote safe travel.

Currently the FAA provides oversight to 110,000 takeoffs and landings with 1.6 million passenger enplanements daily. This is a large and complex responsibility.

Traditionally, the products of a regulatory agency have been rules and regulations. However, over the years we have learned that we cannot "regulate our way to safety" if we hope to make a significant affect on the accident rate. To significantly improve an already great safety record takes a more sophisticated approach to include partnerships between a variety of government and industry organizations.

In addition to our on-going vigilance, we have initiated selected new key Initiatives to promote safety in partnership with industry. These initiatives have resulted in several .safety interventions and will help us achieve our stated goal of reducing the accident rate by 80% from 1996 to 2007.

Some of the initiatives include:

Safer **Skies** to concentrate resources on the most prevalent causes of incidents and accidents.

Global Aviation Information System (GAIN) to share safety information worldwide.

Plain Language to provide regulations in plain language.
And
FAA Reinventlon Journey to raise FAA effectiveness and efficiency.

Air Transportation Oversight System (ATOS) to provide a systems approach to airline oversight.

Large and general goals and initiatives, like the ones I just mentioned, must be narrowed to specific targets of opportunity in order to achieve the overall objective. For example, the Safer Skies is a multi-pronged approach which Includes General Aviation, Commercial Aviation, and Cabin Safety. Two significant approaches that complement Safer Skies are improved data analysis and human factors in operations and maintenance. Safer Skies also places increased emphasis on the partnerships between FAA and the aviation industry.

The topic of this conference is "Aviation Maintenance Human Factors, Safety Management: Theory into Practice". The focus of the human and the safety management of the human are an important and specific perspective that has high payoff. During this symposium we must identify and share the best ways to manage aviation systems to minimize human error. This management is important because, as Dr. Reason and others Indicate, it is often the organizational issues that have a significant impact on the human performance issues.

It is appropriate for me as the symposium's FAA spokesperson to talk about 'Theory into Practice." Since 1988 we in the Flight Standards Service have worked closely with the Office of Aviation Medicine to ensure that our human performance research is theoretically sound yet practical enough for immediate industry application. That is "Theory into Practice."

During my speech I wish to speak primarily about our non-regulatory role in maintenance human factors.

First, I want to review a selected example of our research outputs and show how they are applied in the industry and at the FAA Our applied research has extended far beyond our US boundaries. We are proud of that. We also compliment and thank many members of the international aviation community as they, in turn, share their best practices with us.

Second, 1 want to characterize the actions our research team has taken to ensure that the results can be used. It takes a research manager and a team of government and industry professionals to establish a process to define and use research results in an applied way. I will describe those steps.

Finally, I will describe some of the current and expected challenges that we, as a global industry, face over the next five plus years. I will offer some insight on our regulatory as well as research approaches to address these challenges.

Let me share some of our Success Stories

The Office of Aviation Medicine Human Factors in Aviation Maintenance Research Program began in 1988. In fact, some of you may have attended the first Aviation Maintenance and Inspection Human Factors conference that was held in Washington DC in October 1988.

At that conference, the industry participants told the FAA that any maintenance human factors research must be applied. The Office of Aviation Medicine was using terms like "The research shall focus on where the rubber meets the road." As an aside, "Where the tire meets the threshold" may have been more appropriate" In any case, the FAA managers listened closely to the industry to embark on applied research.

Applied research does not ignore good scientific principles. A famous social psychologist of the 30's, Dr. Kurt Lewin, said, "Nothing is as practical as basic scientific research." Therefore FAA identified consultants and university researchers that had not only sound scientific credentials but also had a reputation for "getting their hands dirty.' The researchers had to be applied researchers.

I will cite a report that FAA published in 1998. The report stated:

"The international industry sample of 122 respondents represented al/aspects of the aviation maintenance industry. The results, described herein, show e very active interest in maintenance human factors. Most participants were familiar with the FAA research program and used many of the research by-products. The Research end Development (R&D) program received overall high marks."

As with all the research reports, you can read the entire text at the hfskyway.faa.gov website. So this example leads to our first success story. You can read the entire report on the FAA website.

Let me talk a little about The HFSKYWAY Website

The human factors in aviation maintenance website (hfskyway.faa.gov) has been in existence since 1996. It has received over 6 Million hits in that time frame, indicating a high level of interest. As I mentioned, the website contains ALL of the research publications since 1988. That includes all of the conference proceedings and all of the annual research reports. Theses reports exist as a very large information base. The reports are linked together .... they are not merely a collection of individual reports. We venture to say that this website is the most thorough collection of assimilated maintenance human performance information.

The website contains many of the software programs from the research. They can be down loaded and used. One extremely Innovative source on the website is the SMART training center. The center contains many of the attributes of a typical college or technical training classroom. Students can take a computer-based training class, ask questions of the professor, chat with a group of students, take the tests, and access reading materials and short videos. Some of you are among the first class of 35 graduates that completed the first SMART Maintenance Resource Management course. The US Navy has also used the SMART center to deliver MRM training to Maintenance Officers. Commander John Schmidt led the NAVY effort.

Other non-regulatory products our agency produces are Handbooks and Advisory Circulars

Our industry survey and on-going discussions told us that you wanted Guidelines and Advisory materials. In that vein we created the Maintenance Resource Management Handbook, in 1998, and the Human Factors Good Practices in Fluorescent Penetrant Inspection Handbook, in 1999. Both of these documents are on the website, of course. The documents are applied and prescriptive. They tell you not only what to do but also why you should do it. For example, the FPI book identifies 86 "Best practices" in nondestructive inspection. Then, for each best practice it explains why it is a best practice. Two major engine manufacturers have requested permission to republish portions of the FPI Handbook and the recommendations directly into their engine maintenance manuals. That is 'Theory into Practice."

The MRM Handbook runs the gamut from historical perspectives of CRM, in the cockpit, to step-by-step directions for conducting a needs analysis for training design. If you do not want to design your own, the MRM Handbook has a complete curriculum, including the training objectives and presentation materials. Many organizations have adopted materials from the MRM Handbook. That is 'Theory into Practice."

The MRM Handbook is currently in the final stages of publication as an Advisory Circular. That will join another AC, on NDI Certification and Training. That is a product from the research program. We are planning another on Shift Turnover procedures.

All of the documents are not only from the FAA. Our research Program Manager, Jean Watson (who is in the audience with us), cooperated with the Air Transport Association to create ATA Spec 113, Maintenance Human Factors Program Guidelines. ATA Spec 113 offers a good guideline of what is required to develop a maintenance human factors program within an organization. ATA in an unusual move makes this Spec available to both members and non-members. Much of the basis of this Spec is from the FAA research program.

We have exercised "Theory to Practice" internally at the FAA Flight Standards Service as well.

As an example, in the early to mid nineties the FAA's Aviation Maintenance Human Factors Research Program began using mobile computers for selected maintenance tasks in industry. The team worked with industry partners to evaluate selected aspects of mobile computing. The reports are on the web.

When our Administrator, at that time General Richards, saw what the research team was doing with industry he redirected some of the effort to focus on our FAA inspectors. The resulting system is the FAA On-line Aviation Safety Inspection System (OASIS). It is used by nearly every Flight Standards inspector today. All of our inspectors will have the system by the end of this year. The research team applied systems engineering, task analysis, user-centered design, knowledge management techniques, and human computer interface design to build the OASIS system. This is one of our showcase examples of how we transitioned "Theory into Practice."

There Is A Long List of Applied Research Products and Industry Users

Time prevents me from telling you about every example of successful implementation of the research products. In addition, much of these research results can be and are applied to other areas besides aviation maintenance. One that immediately comes to mind, in a long list of many other examples, is NASA at the Space Center which is using the research program's Document Design Aid software and guidelines for shuttle maintenance and processing. The same tools have been adopted by the New York City Busing Authority to rewrite bus repair manuals and by the Alaska Pipeline to rewrite their maintenance documents. That is also "Theory into Practice

The examples that I have cited beg the question, “What must one do to put theory into practice?" Successful implementation of theory into practice starts in the requirements definition. A reasonable mix of practitioners and researchers must develop the requirements. Neither group can operate independently as the research requirements are defined.

The first conference in 1988 had the expressed objective of asking industry what they needed. At the same time we asked the scientific community what they could offer. About the same time we assembled a group of aviation professionals to write the ***National Plan for Aviation Human Factors.*** That document created a listing of needs and milestones for development. The ***National Plan*** guided FAA research into the mid nineties. By that time the industry groups, like the Air Transport Association, formed committees for Human Factors, for Maintenance Training, for Electronic Documentation, and more. Of equal importance is the fact that industry opened their doors to our research teams. Every member of the FAA research team spent time in 'the shops and on the ramp. Our researchers worked on all shifts to thoroughly understand maintenance operations.

While the time on the shop floor was important our team also spent time in the executive offices. Many an airline Vice President and Director worked with members of the research team: The industry partners asked for and received practical answers to their questions. In most cases the answers were transferable to the entire industry. AND, the results were published and widely disseminated, first as paper, then as CD-ROMS, and now on the internet. In fact, because of the internet technology, this is the first symposium in five years that we are not distributing CD-ROMs. That is progress!

Our theory transitioned to practice because industry was our partner. Not only did these partners provide facilities and people, but they also made firm commitments to implement the research products. For example, Delta co-developed and tested a variety of training systems. US Airways worked with Dr. Drury on Job Cards, Documentation, and Simplified English. Continental and United cooperated on many of our efforts at measuring the impact of MRM programs. Northwest Airlines worked with documentation and procedural research. Repair stations also became partners. BF
Goodrich Aerospace, Lockheed-Martin Aerospace, and United Services all opened their doors to our teams. In fact the research goes back far enough to acknowledge early participation from airlines such as PanAM and Eastern. Many international airlines in Asia, Canada, Europe, and the United Kingdom hosted members of our

research team. While this list is incomplete it serves to illustrate the point that applied research takes place in applied settings. Thank you again to our many industry partners.

We have government partners too. As part of the FAA/NASA Aviation Safety Plan, NASA researchers ere working with our FAA team. This results in higher quality programs and eliminates redundant programs. The Department of Defense, and all the services, takes an active role in the research activity. Again, this involvement helps to ensure that the theories become applied practice.

In this final portion of my talk, this morning, I will briefly describe a few of our current and expected future safety challenges. I will not only give our general philosophy but also some very specific approaches we are taking. These approaches can be described as individual topics.

Communication, Data, and Information

Clear, consistent, and timely information is high priority for both government and industry. This communication must take place within FAA ranks, with our operators, and among international regulatory authorities. Technologies, like e-mail, web sites, broadcast Faxes, and of course, telephone can certainly keep us connected as a global entity. But communication is more than the physical connection.

Communication of critical data requires that a reasonable format and procedures be established. Programs like GAIN are defining the ways we are going to collect, analyze and share information. Technologies like Knowledge Management are beginning to help us organize and define the business rules and information flow that will contribute to optimal communication of getting the "Right" information to the "right person" at the "right time."

As an industry we are struggling with standard ways for maintenance personnel to report errors without suffering job-related consequences. When maintenance personnel see a serious problem they must be able to report it, without being labeled a "Whistle Blower." The President of the United States challenged us to find means to report errors.

As a result, on January 14, 2000, President Clinton announced Initiation of the FAA Aviation Action Safety Programs (ASAP). The objective of ASAP is to enhance aviation safety through accident and Incident prevention programs. These programs are designed to encourage airline management and employee groups, such as flight crewmembers, mechanics, flight attendants, and dispatchers to voluntarily provide safety information that would otherwise be unobtainable. Ultimately, the safety data collected and analyzed is to be used to develop corrective actions for identified safety concerns and to educate the appropriate parties to prevent the reoccurrence of identified safety issues. ASAP is based on a safety partnership that will include the FAA and certificate holders and may include a third party such as an employee group. Increasing communication hardware capability and electronic bandwidth will also help to ensure faster and clearer transmission of video, audio, and other safety information. These communication avenues will help us to design end implement ways for industry to share the data collection and analysis tasks, using shared databases.

The increased use of Repair Stations to accomplish airline maintenance has highlighted the need for their involvement as well.

Repair stations have been an important method to help ensure that aircraft are available to meet the demand for air travel. Repair stations have fostered competition for all maintenance services by offering cost benefits. Without repair stations many airlines could not exist. One of our FAA responsibilities is to partner with the repair station industry to ensure their products and services comply with the regulations and are safe. The system is working and there are always opportunities for improvement.

The communication and information issues, cited earlier, can be very helpful when applied to repair station oversight. Good data can help the industry and the regulators monitor selected performance indicators of repair stations and their personnel. We expect that quality FAA inspector tools, like OASIS and the Air Transport

Oversight System (ATOS), can help standardize our surveillance. At FAA we are striving to reduce the regional differences that occur in repair station oversight.

ATOS is the new air carrier oversight process developed by Flight Standards, under a Partnership for Safety Charter with our inspector union and with the support of Sandia National Laboratories. While it does not yet include repair stations, It will in the near future

Shifting to our traditional role of rulemaking, I would now like to move into the area of Personnel Certification

When we proposed a new rule in 1998, 14 CFR Part 66 for certification of Aviation Maintenance Technicians, we received over 2200 comments that did not necessarily agree with our plan. We are still regrouping from that response as we determine the best ways to certify maintenance personnel for this evolving industry. Right now much of the industry takes responsibility for providing necessary additional training for newly licensed personnel. This system works only if the industry can afford to design and deliver such training. We know that such training does not always happen. We are also aware that there is an increasing shortage of properly qualified maintenance personnel. We must continue to partner with the industry, schools, and the military to find solutions to this challenge.

· **Summary**

To summarize, I first must reiterate that as a global industry we are doing well. We are quite safe. Any one of us is very comfortable to board our children, our spouses, our parents on any scheduled flight throughout the world. But, we can do better. We must do better. The current accident rate must and shall go down as the number of departures goes up. How will we do this?

We must continue to look for other challenges and solutions to improve an overall aviation system safety philosophy, but particularly in aviation maintenance we must continue to provide practical research solutions which mitigate human-centered aviation maintenance and inspection safety issues. We must focus on error avoidance and prevention to reduce responses by maintainers and inspectors whether by commission, omission, inadequacy or timing, address those properties of the working environment which may affect individual maintainer performance. We must enhance entry level maintainer skill sets to closer match job requirements, identify improvements to enhance the proficiency of technicians and inspector workforce and provide methods to maintain required proficient levels within a trained workforce.

We must take the necessary steps to reduce human error in aviation maintenance. We humans are the #1 cause of accidents. SO, the Industry must continue to support the human in order to improve the safety statistics. We do this with improved methods for selection, for training, for delivering procedures and current information. We must make hardware and software tools smarter. We must take a close look at management systems, including information systems, to reduce the possibility of creating the latent conditions that permit the human to fail. As regulators we must strive to support the kind of industry thinking and action that designs the maintenance system for safety and success. That is not a small job but it is the one that we accept.

Thank You, I look forward to visiting with many of you over the course of this symposium.